

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554**

<b>In the Matter of</b>	)	
<b>Request of PTC-220, LLC for Waivers of</b>	)	<b>WT Docket No. 13-59</b>
<b>Sections 90.729(b) and 90.723(f) of the</b>	)	
<b>Commission's Rules</b>	)	

**To: Chief, Wireless Telecommunications Bureau**

**COMMENTS OF THE  
NATIONAL RURAL TELECOMMUNICATIONS COOPERATIVE**

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**April 8, 2013**

## TABLE OF CONTENTS

SUMMARY .....	iii
I. BACKGROUND .....	2
II. COMMENTS .....	4
1. NRTC’s and PTC-220’s Respective 220-222 MHz License Holdings Are In Close Geographic And Spectral Proximity. ....	4
2. NRTC Supports Positive Train Control and Other Efforts to Develop the 220-222 MHz Band.....	7
3. NRTC’s Rights Under Its Existing 220-222 MHz Licenses Will Be Substantially Undercut If PTC-220 Were Permitted To Use Higher Antennas and More Power Than Currently Authorized In The Rules. ....	8
4. PTC-220’s Waiver Request Is Incomplete. ....	9
5. PTC-220 Has Not Made A Compelling Case That Grant Of Its Waiver Request Is Necessary For The Deployment Of PTC. ....	10
6. While NRTC Opposes The Waiver Request, It Supports The Consideration Of PTC-220’s Proposal Through Formal Rulemaking .....	12
III. CONCLUSION .....	14
<b>APPENDIX I</b>	
<b>APPENDIX II</b>	

## SUMMARY

NRTC opposes PTC-220, LLC's waiver request to exceed the antenna height and effective radiated power limits and avoid the coordination requirements in Sections 90.723(b) 90.723(f) of the Commission's rules, respectively. Although NRTC supports the deployment of Positive Train Control technology and recognizes the public interest benefits thereof, grant of the requested waiver will potentially have a significant negative impact on the current and future deployments of other 220-222 MHz band licensees, including NRTC.

NRTC's subsidiary, NRTC LLC, holds several licenses in the 220-22 MHz band, many of which are in close geographic and spectral proximity to PTC-220's licenses. These licenses were acquired on the secondary market and are used primarily by electric, gas, and water utilities for fixed telemetry and two-way voice communications. NRTC LLC also has made its licenses available for Positive Train Control.

NRTC has expended considerable resources to deploy and construct its 220-222 MHz system in accordance with the Commission's requirements and is concerned that a unilateral grant of PTC-220's Waiver Request will unfairly undercut NRTC's license rights and degrade its ability to expand its system in the future. On the other hand, PTC-220's request focuses nearly entirely on financial benefits of the waiver. It is not clear from PTC-220's waiver request that the requested relief is necessary to deploy Positive Train Control in a timely manner.

If PTC-220's request for waiver of Section 90.723(b) of the Commission's rules is granted without an increase in the required distance separation, both co- and adjacent channel interference is likely to occur to receivers already deployed in the 220-222 MHz band. NRTC is supplying a technical analysis of the interference potential. Further, PTC-220's request exceeds the relief appropriate for the waiver process by effectively asking the Commission to condition other 220-222 MHz band licenses on observing coordination obligations that were not adopted pursuant to rulemaking prior to deploying future sites.

NRTC would be pleased to participate constructively with PTC-220, other 220-222 MHz licensees, interested parties, and the FCC, in a rulemaking proceeding to harmonize the 220-222 MHz band's rules with current and expected new technologies, all while protecting incumbent operators' systems. Without substantial concessions to protect NRTC and other 220-222 MHz licensees who developed their systems in reliance on the Commission's existing rules, however, NRTC opposes PTC-220's Waiver Request.

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<b>Request of PTC-220, LLC for Waivers of</b>	)	<b>WT Docket No. 13-59</b>
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**To: Chief, Wireless Telecommunications Bureau**

**COMMENTS OF THE  
NATIONAL RURAL TELECOMMUNICATIONS COOPERATIVE**

The National Rural Telecommunications Cooperative ("NRTC") hereby submits its Comments regarding PTC-220, LLC's ("PTC-220's") Request for Waiver of Sections 90.729(b) and 90.723(b) of the Commission's rules to increase certain power and height limitations for the deployment of a 220-222 MHz band network for Positive Train Control ("PTC").<sup>1</sup> NRTC's subsidiary, NRTC LLC, holds extensive licenses in the 220-222 MHz band, which were acquired on the secondary market. NRTC has expended considerable resources to deploy and construct its 220-222 MHz system in accordance with the Commission's requirements. Many of NRTC LLC's licenses are in close geographic and spectral proximity to PTC-220's licenses.

NRTC supports the deployment of Positive Train Control ("PTC") technology but is concerned that a unilateral grant of PTC-220's Waiver Request will unfairly undercut NRTC's license rights and degrade its ability to expand its system in the future. Without substantial concessions to protect NRTC and other 220-222 MHz licensees who developed their systems in reliance on the Commission's existing rules, NRTC opposes PTC-220's Waiver Request.

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<sup>1</sup> Public Notice, *The Wireless Telecommunications Bureau and the Office of Engineering and Technology Seek Comment on Waiver to Facilitate Deployment of Positive Train Control Systems*, WT Docket No. 13-59 (rel. Mar. 8, 2013) ("Public Notice").

Finally, NRTC opposes the Waiver Request on procedural grounds, noting that sweeping national changes such as those proposed in the Waiver Request are more suited to a traditional notice and comment rulemaking proceeding. NRTC would be pleased to participate constructively with PTC-220, other 220-222 MHz licensees, interested parties, and the FCC, in any such proceeding to harmonize the band plan's rules with current and expected new technologies, all while protecting incumbent operators' systems.

## **I. BACKGROUND**

NRTC is a non-profit cooperative association representing the interests of more than 1,500 rural utilities and affiliates in 48 states. NRTC's mission is to ensure that state-of-the-art telecommunications services are available throughout rural America, just as they are in more urbanized areas.<sup>2</sup> NRTC achieves its mission through investing in, developing, and deploying products and services through aggregating the collective strengths of its members.

NRTC is the manager and majority interest holder of NRTC LLC. NRTC LLC holds the following licenses in the 220-222 MHz band: (1) a 5-channel Phase I Nationwide license (WPCU 518); (2) a 10-channel Phase II Nationwide license (WPOI 700); (3) six 7-channel Phase II Regional licenses (WPOL 329-334); and (4) a 15-channel Phase II Regional license (WPOK 780). NRTC LLC incorporates these licenses into a network of twenty-two 5 kHz channels effectively covering the entire United States, including all of rural America.

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<sup>2</sup> To that end, in addition to 220 MHz, NRTC has invested in DirecTV, WildBlue Satellite Service, Internet access, rural cellular, meter reading, smart grid and other telecom technologies in rural America. By aggregating its members' buying power, NRTC ensures the delivery of products and services developed specifically to meet the needs of rural utilities and their customers, such as broadband access via satellite, full service Internet access and support, integrated smart grid technologies and energy efficiency solutions, wireless technologies, long distance programs, mobile phone service, IP backbone services, and programming distribution rights for video providers.

On December 18, 2012, the Commission found that NRTC had satisfied all relevant construction requirements applicable to its 220-222 MHz licenses to date.<sup>3</sup>

NRTC LLC acquired its licenses through secondary market transactions to help satisfy the telecommunication needs of its members.<sup>4</sup> The characteristics of the 220-222 MHz band, in particular the expansive two-way communication range that can be achieved, make it ideally suited for voice and data communication in rural areas. Given that NRTC's individual utility members' electric service territories are significantly smaller than, or do not otherwise, match the 220-222 MHz geographic area license areas available at auction by the FCC, it was impractical for individual utilities to acquire licenses on their own, so consistent with its mission NRTC formed an LLC with its members and acquired the spectrum on their behalf.

NRTC LLC makes its 220-222 MHz channels available to NRTC's members and others for wireless communications necessary to promote the safe and efficient operation of electric distribution systems and other core business applications. Rural electric cooperatives and other utilities have come to rely on these frequencies to support their critical internal operations. NRTC LLC also has made, and continues to make, its licenses available for Positive Train Control and land mobile operations in urban areas.<sup>5</sup>

NRTC LLC's system has become an indispensable tool for ensuring the safe and efficient delivery of critical electric services by rural electric cooperatives and other electric utilities across the country. It is used to serve consumers in rural, remote, insular and isolated communities, as well as in more populated areas.

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<sup>3</sup> Letter from Thomas P. Derenge, Deputy Chief, Mobility Division, Wireless Telecommunications Bureau, to Robert A. Fuhrer, Vice President & General Counsel, NRTC, dated Dec. 18, 2012.

<sup>4</sup> For example, NRTC LLC acquired its phase II 220 MHz licenses on the secondary market from Intek License Acquisition Corporation. *See e.g.*, ULS File No. 0000016347.

<sup>5</sup> *See, e.g.*, ULS File Nos. 0005040605, 0005040607 (spectrum partition to PHI Service Company ("Pepco")), 0004573974 (spectrum partition to GE Transportation Systems Global Signaling, LLC), Letter from Jack Harvey, NRTC, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 11-79, at 1 (July 11, 2011).

NRTC LLC does not use its 220-222 MHz system to provide a subscriber-based service that is interconnected with the public switched telephone network and supported by commercial fees. Rather, it is a critical radio frequency tool used for private, internal purposes by utilities for fixed telemetry and two-way voice communications primarily to ensure the safe and efficient generation, transmission and distribution of electric utility services, including “smart grids.”<sup>6</sup> It also is used in responding to various emergency situations, including hurricanes, floods, fires and other natural disasters in remote, sparsely populated areas. Rural electric cooperatives using these frequencies routinely work alongside local public safety agencies in promptly restoring electric service following these types of emergency events.

The current operational footprint of NRTC’s system is not static. Instead, NRTC continues to market and deploy the system and expand into new and previously unserved areas. NRTC’s licenses are effectively nationwide, with many areas targeted for future growth. To succeed, the system cannot be “frozen in time” via limitations on future growth resulting from a rule waiver benefitting a single entity.

## **II. COMMENTS**

### **1. NRTC’s and PTC-220’s Respective 220-222 MHz License Holdings Are In Close Geographic And Spectral Proximity.**

As indicated in Appendix I and depicted below, NRTC holds several licenses that are adjacent to PTC-220’s licenses and would be directly impacted by PTC-220’s proposed operations. For instance, NRTC holds a 5-channel Phase I Nationwide license under call sign WPCU 518 authorizing five 5 kHz channels (220.775-220.800/221.775-221.800 MHz) for nationwide operations. PTC-220 also holds a 5-channel Phase I Nationwide license under call

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<sup>6</sup> NRTC’s system supports a variety of “smart grid” and utility communication applications including two-way Supervisory Control and Data Acquisition (SCADA) communication systems for substation communication, automated metering infrastructure, and voltage conservation; and one-way communication systems for distribution automation, demand response, and workforce management.

sign WFPF 444 authorizing the five 5 kHz channels (220.750-220.775/221.750-221.775 MHz) adjacent to NRTC's nationwide operations. Additionally, NRTC holds six 7-channel Phase II Regional licenses (WPOL 329-WPOL 334) which together create nationwide coverage in the lower portion of Channel Block J (220.925-220.960/221.925-221.960 MHz). Similarly, PTC-220 holds six 7-channel Phase II Regional licenses (WPOI 702-WPOI 706, WPOI 708) which also create nationwide coverage in the adjacent upper portion of Channel Block J (220.960-221.000/221.960-222.000 MHz).



**Figure 1. Channel matrix for the 220-222 MHz band depicting the channels assigned to NRTC LLC and PTC-220.**

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35
36	37	38	39	40
41	42	43	44	45
46	47	48	49	50
51	52	53	54	55
56	57	58	59	60
61	62	63	64	65
66	67	68	69	70
71	72	73	74	75
76	77	78	79	80
81	82	83	84	85
86	87	88	89	90
91	92	93	94	95
96	97	98	99	100
101	102	103	104	105
106	107	108	109	110
111	112	113	114	115
116	117	118	119	120
121	122	123	124	125
126	127	128	129	130
131	132	133	134	135
136	137	138	139	140
141	142	143	144	145
146	147	148	149	150
151	152	153	154	155
156	157	158	159	160
161	162	163	164	165
166	167	168	169	170
171	172	173	174	175
176	177	178	179	180
181	182	183	184	185
186	187	188	189	190
191	192	193	194	195
196	197	198	199	200

NRTC LLC

PTC-220

## **2. NRTC Supports Positive Train Control and Other Efforts to Develop the 220-222 MHz Band.**

NRTC agrees with PTC-220 that the 220-222 MHz band is a significant spectrum resource for innovative services used by critical infrastructure companies such as railroads, utilities, and energy companies, and has expended substantial time and capital to develop third party relationships necessary to promote deployment in the 220-222 MHz band.

NRTC has deployed its 220-222 MHz licenses in support of a growing, vibrant market of services developed by rural electric cooperatives; those services are now available to others despite difficult regulatory and technological challenges over the years. For example, NRTC invested substantially in the development of an IP-based voice technology to meet voice dispatch requirements. NRTC funded engineering and product development for hardened IP/Ethernet and Serial transceivers for two-way data applications and is aiding the development of cognitive radio technologies for use in the band.<sup>7</sup> NRTC also successfully deployed two-way voice communications in a number of rural and more densely populated areas and partitioned part of its spectrum to an electric utility in the mid-Atlantic area.<sup>8</sup>

NRTC recognizes the crucial role PTC plays in improving the safety and reliability of rail operations and supports the goal PTC-220 seeks to achieve through the waiver.<sup>9</sup> NRTC also appreciates the public interest benefits of PTC and agrees that the 220-222 MHz band is suitable for PTC deployment. NRTC LLC has even worked directly with GE Transportation and Amtrak over the years to provide spectrum for PTC technology.<sup>10</sup> But NRTC disagrees

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<sup>7</sup> The innovations of NRTC and others to introduce two-way data communication in the 220 MHz band is an example of how innovation can occur in harmony with current rules and regulations and not be disruptive to the existing or future uses within the band.

<sup>8</sup> ULS File Nos. 0005040605, 0005040607 (spectrum partition to PHI Service Company (“Pepco”).

<sup>9</sup> See n. 4, *supra*.

<sup>10</sup> ULS File No. 0004573974 (spectrum partition to GE Transportation Systems Global Signaling, LLC).

that its full panoply of rights as a 220-222 MHz licensee may be limited or otherwise degraded now or in the future by grant of the requested waiver to PTC-220.

**3. NRTC's Rights Under Its Existing 220-222 MHz Licenses Will Be Substantially Undercut If PTC-220 Were Permitted To Use Higher Antennas and More Power Than Currently Authorized In The Rules.**

NRTC is a well-established 220-222 MHz licensee of more than 10 years standing. As a licensee, NRTC has complied with the Commission's rules and requirements applicable to the 220-222 MHz band, including those regarding timely construction.<sup>11</sup> At this late date, it is inappropriate through the waiver process for the Commission to impose new restrictions on the location, power, or antenna height of stations that are inconsistent with the rules at the time NRTC acquired its licenses. To grant a waiver to PTC-220 that would impair NRTC's ability to continue building-out its system in accordance with applicable Commission rules would be unfair and prejudicial.

NRTC has demonstrated that new and innovative services such as PTC can be introduced consistent with current FCC rules and regulations without a waiver of existing requirements. The waiver process should not be used to grant new rights to a particular 220-222 MHz band licensee that potentially supersede the rights of other licensees in the band who relied on and acted consistent with the Commission's existing requirements.

The impact of the proposed waiver on NRTC's licenses would be significant. As described in Appendix II, both co- and adjacent channel interference is likely to occur with respect to existing 220-222 MHz sites unless the required separation distance is increased. NRTC's operations would be directly impacted by PTC-220's proposed operations under the Waiver Request. The requested waiver would permit the company to deploy PTC nationwide at

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<sup>11</sup> See, NRTC LLC Construction Showing Or, Alternatively, Request For Waiver Or Extension, dated March 22, 2012.

a higher ERP and higher antenna heights than what NRTC has already deployed. Operations at these increased levels would create harmful interference to NRTC's existing operations as well as future expansion of its system, particularly along the edges of NRTC's spectrum directly adjacent to PTC-220's system.

#### **4. PTC-220's Waiver Request Is Incomplete.**

PTC-220's Waiver Request relies exclusively on limits contained in Sections 90.723(d)-(e) of the Commission's rules to protect receivers when expanded to cover the frequencies proposed by PTC-220. These rules were developed in 1989, however, to protect incumbent Phase I licensed receivers in a limited, restricted portion of the band at issue.<sup>12</sup> PTC-220 fails to provide any credible technical evidence to show that the protections in Sections 90.723(d)-(e), which were limited to specific frequencies and based on technologies either readily available or contemplated at the time of the rulemaking, will afford an appropriate level of protection to receivers in this instance.

PTC-220's system relies on a fundamentally different technology, in terms of network deployment topology, transmitted waveform, and duplexing scheme, than the systems on which the original rules were developed. All of these factors may lead to a different interference potential and may prove the current limits to be inadequate to fully protect incumbent receivers.

Further, PTC-220 has not provided a comprehensive request that identifies all relevant technical parameters. For example, under Sections 90.723(d)-(e), the radiated power limits are based on the transmitter peak envelope power. PTC-220 has not addressed how this peak envelope power will be measured for its TDD-based system. PTC-220 also has not addressed

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<sup>12</sup> Amendment of Part 90 of the Commission's Rules to Provide for the Use of the 220-222 MHz Band by the Private Land Mobile Radio Services, *Notice Of Proposed Rule Making*, 4 FCC Rcd 8593 (1989).

the applicable limitations on power and antenna height under Section 90.729(a), which currently applies only to “land mobile, paging, or fixed stations transmitting in the 220-221 MHz band.”

Together, these shortcomings demonstrate the need for a more fulsome consideration of these types of technical issues and others under a thorough rulemaking proceeding where all affected licensees may review and comment on these proposals before their licenses are adversely affected through a fast-track waiver process.

#### **5. PTC-220 Has Not Made A Compelling Case That Grant Of Its Waiver Request Is Necessary For The Deployment Of PTC.**

Congress mandated that railroads deploy PTC by December 31, 2015, but Congress did *not* designate the 220-222 MHz band for this purpose. Rather, PTC-220 selected the 220-222 MHz band with full knowledge that NRTC and others already held licenses and had developed their own systems in this band in reliance on the FCC’s existing rules.

It also is not clear from PTC-220’s Waiver Request that the statutory deadline is in jeopardy of being missed if the waiver were not granted. PTC-220 does not claim that PTC deployment cannot be completed absent the waiver, or that sufficient spectrum is not available for PTC deployment in this band or elsewhere -- only that additional sites may be required if the deployment is to occur at 220-222 MHz. Rather than commit to constructing additional sites in accordance with the existing rules, PTC-220 seeks a series of waivers designed to facilitate their own planned deployment at the expense of others already licensed and deployed in the band.

PTC-220 repeatedly focuses on the financial implications and value of its spectrum, but the showings are not compelling. For example, PTC-220 states that without the requested waivers, PTC deployment in the Chicago area could cost an additional \$2 million – compared to

the more than *\$13 Billion* the Federal Railroad Administration estimates it will cost to deploy and maintain PTC over the next 20 years.

PTC-220 has not shown that the burden to PTC deployment under the existing rules is so high that PTC-220's rights should override the rights of other licensees who relied on a fixed regulatory environment applicable equally to all, especially since the burden on PTC-220 appears to be primarily financial. It is particularly inappropriate to favor PTC applications at this point since many of the current non-PTC uses of the 220-222 MHz band also are for critical infrastructure purposes that likewise satisfy regulatory requirements or are otherwise in the public interest.

In considering PTC-220's Waiver Request, the FCC must ensure that it does not increase the risk of interference to other types of critically important systems, either now or in the future. For example, many of NRTC's users operate electric utility monitoring and control systems in the 220-222 MHz band. These systems are used to protect safety of life and property and ensure the availability of electric service, including in emergency and disaster response. As stated above, NRTC also has made its spectrum available to other railroads for PTC deployments. Grant of the requested waivers, without adequate conditions to protect existing and future operations in the band by other licensees, has the potential to fundamentally change the nature of the band and adversely impact investment and innovation.

No waiver to PTC-220 should place undue obligations on other licensees that acquired spectrum and plan to expand their systems in reliance on the Commission's existing rules governing this band. Absent a rulemaking, any conditions or obligations to protect fully all incumbent licensees now and in the future must fall squarely on PTC-220. PTC-220 must not

be allowed to commandeer the band in a way that promotes PTC but stymies investment, innovation, and growth of other important services.

## **6. While NRTC Opposes The Waiver Request, It Supports The Consideration Of PTC-220's Proposal Through Formal Rulemaking**

NRTC opposes the Waiver Request noting that sweeping national changes such as those proposed in the Waiver Request are more suited to a traditional notice and comment rulemaking proceeding. In total, this waiver request together with the waivers previously granted to PTC-220 represent fundamental change to 220-222 MHz band and such change is being effected on a singular, one-off basis rather than on a comprehensive and cumulative basis.

An agency action may constitute an abuse of discretion where the agency conducts a *de facto* rulemaking proceeding through adjudication, such as grant of a waiver.<sup>13</sup> Adjudications typically “resolve disputes among specific individuals in specific cases, whereas rulemaking affects the rights of broad classes of unspecified individuals.”<sup>14</sup> Here PTC-220 does not merely request waiver of certain rules applicable to its licenses. It effectively asks that the licenses of other 220-222 MHz band licensees be conditioned on coordination obligations that were not adopted pursuant to rulemaking. Grant of PTC-220's request would place obligations on NRTC and its members that did not exist at the time NRTC LLC invested in the 220-222 MHz band. For that reason, the request is more appropriately addressed through rulemaking, rather than through waiver.

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<sup>13</sup> See *Am. Airlines, Inc. v. Dep't of Transp.*, 202 F.3d 788, 798 (5th Cir. 2000) (reviewing agency's decision to proceed by adjudication rather than rulemaking for abuse of discretion). see also *NLRB v. Bell Aerospace Co.*, 416 U.S. 267, 294 (1974) (“[T]here may be situations where [an agency's] reliance on adjudication would amount to an abuse of discretion....”).

<sup>14</sup> *Yesler Terrace Cmty. Council v. Cisneros*, 37 F.3d 442, 448 (9th Cir. 1994); see also *Providence Yakima Med. Ctr. v. Sebelius*, 611 F.3d 1181, 1187-88 (9th Cir. 2010) (per curiam); *San Juan Cable LLC v. P.R. Tel. Co., Inc.*, 612 F.3d 25, 33 n.3 (1st Cir. 2010).

NRTC would be pleased to participate constructively with PTC-220, other 220-222 MHz licensees, interested parties, and the FCC, in any such proceeding to harmonize the band plan's rules with current and expected new technologies, all while protecting incumbent operators' systems . PTC-220 is not the sole user of 220-222 MHz spectrum for PTC and surely other current and future users of the 220-222 MHz band for PTC may benefit, or require the same flexibility that PTC-220 is requesting through its waiver and would be best addressed through a single rulemaking. Processing numerous, individual waiver requests is an administrative burden for the FCC and other licensees and it misses the opportunity to harmonize such requests under a common framework.



### III. CONCLUSION

NRTC has been substantially committed to the 220-222 MHz band for more than 10 years. It holds extensive license assets in the band, all of which were acquired either at auction or on the secondary market, and many of which are in close geographic and spectral proximity to PTC-220's licenses. Having expended considerable sums and efforts to deploy and construct its 220-222 MHz system in accordance with the Commission's requirements, NRTC believes that a unilateral grant of PTC-220's Waiver Request will unfairly undercut NRTC's license rights and degrade its ability to deploy further sites in the future. NRTC supports the development of PTC and the development of new technologies generally for 220 licensees, therefore NRTC can be counted on to proactively and constructively participate in any rulemaking for the 220 band plan. NRTC's support, however, is not at the expense of its rights as a longtime 220-222 MHz licensee.

/s/

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April 8, 2013

## APPENDIX I

Call Sign	Name	Radio Service	Market	Channel Block	Frequencies
<a href="#">WPCU518</a>	NRTC LLC	NC	Nationwide	Commercial 5 channel	220.775-220.780 220.780-220.785 220.785-220.790 220.790-220.795 220.795-220.800 221.775-221.780 221.780-221.785 221.785-221.790 221.790-221.795 221.795-221.800
<a href="#">WPOI700</a>	NRTC LLC	QA	Nationwide	Channel Blk K	220.250-220.300 221.250-221.300
<a href="#">WPOK780</a>	NRTC LLC	QA	EAG003 - Southeast	Channel Blk G	220.015-220.020 220.040-220.045 220.065-220.070 220.165-220.170 220.190-220.195 220.215-220.220 220.315-220.320 220.340-220.345 220.365-220.370 220.465-220.470 220.490-220.495 220.515-220.520 220.615-220.620 220.640-220.645 220.665-220.670 221.015-221.020 221.040-221.045 221.065-221.070 221.165-221.170 221.190-221.195 221.215-221.220 221.315-221.320 221.340-221.345 221.365-221.370 221.465-221.470 221.490-221.495 221.515-221.520 221.615-221.620 221.640-221.645 221.665-221.670

<a href="#">WPOL329</a>	NRTC LLC	QA	EAG001 - Northeast	Channel Blk J	220.925-220.960 221.925-221.960
<a href="#">WPOL330</a>	NRTC LLC	QA	EAG002 - Mid Atlantic	Channel Blk J	220.925-220.960 221.925-221.960
<a href="#">WPOL331</a>	NRTC LLC	QA	EAG003 - Southwest	Channel Blk J	220.925-220.960 221.925-221.960
<a href="#">WPOL332</a>	NRTC LLC	QA	EAG004 - Great Lakes	Channel Blk J	220.925-220.960 221.925-221.960
<a href="#">WPOL333</a>	NRTC LLC	QA	EAG005 - Central/Mtn	Channel Blk J	220.925-220.960 221.925-221.960

a. **PTC-220's 220-222 MHz licenses**

Call Sign	Name	Radio Service	Market	Channel Block	Frequencies
<a href="#">WPFP444</a>	PTC-220, LLC	NC	Phase 1 Nationwide	Commercial 5 channel	220.750-220.755 220.755-220.760 220.760-220.765 220.765-220.770 220.770-220.775 221.750-221.755 221.755-221.760 221.760-221.765 221.765-221.770 221.770-221.775
<a href="#">WPFR284</a>	PTC-220, LLC	NC	Phase 1 Nationwide	Commercial 5 channel	220.125-220.130 220.130-220.135 220.135-220.140 220.140-220.145 220.145-220.150 221.125-221.130 221.130-221.135 221.135-221.140 221.140-221.145 221.145-221.150
<a href="#">WPOI701</a>	PTC-220, LLC	QA	Nationwide	Channel Blk L	220.400-220.450 221.400-221.450
<a href="#">WPOI702</a>	PTC-220, LLC	QA	EAG001 - Northeast	Channel Blk J	220.960-221.000 221.960-222.000
<a href="#">WPOI703</a>	PTC-220, LLC	QA	EAG002 - Mid-Atlantic	Channel Blk J	220.960-221.000 221.960-222.000
<a href="#">WPOI704</a>	PTC-220, LLC	QA	EAG003 - Southeast	Channel Blk J	220.960-221.000 221.960-222.000
<a href="#">WPOI705</a>	PTC-220, LLC	QA	EAG004 - Great Lakes	Channel Blk J	220.960-221.000 221.960-222.000
<a href="#">WPOI706</a>	PTC-220, LLC	QA	EAG005 -	Channel Blk J	220.960-221.000

			Cetnral/Mtn		221.960-222.000
<a href="#">WPOI708</a>	PTC-220, LLC	QA	EAG006 - Pacific	Channel Blk J	220.960-221.000 221.960-222.000
<a href="#">WPOI774</a>	PTC-220, LLC	QA	BEA073 - Memphis, TN-AR- MS-KY	Channel Blk E	220.850-220.900 221.850-221.900
<a href="#">WPOI800</a>	PTC-220, LLC	QA	BEA096 - St. Louis, MO-IL	Channel Blk E	220.850-220.900 221.850-221.900
<a href="#">WPOJ271</a>	PTC-220, LLC	QA	Nationwide	Channel Blk M	220.700-220.750 221.700-221.750
<a href="#">WPOJ279</a>	PTC-220, LLC	QA	BEA106 - Rochester, MN- IA-WI	Channel Blk E	220.850-220.900 221.850-221.900
<a href="#">WPOJ280</a>	PTC-220, LLC	QA	BEA107 - Minneapolis-St. Paul, MN-WI-IA	Channel Blk E	220.850-220.900 221.850-221.900
<a href="#">WPOJ281</a>	PTC-220, LLC	QA	BEA163 - San Francisco- Oakland-San Jose, CA	Channel Blk E	220.850-220.900 221.850-221.900
<a href="#">WPVL860</a>	PTC-220, LLC	QA	BEA160 - Los Angeles- Riverside-Orange County, CA-AZ	Channel Blk E	220.850-220.900 221.850-221.900

## Appendix II

### **Analysis of Interference Potential and Coordination Requirements for High Power Base Station Operation in the 220-222 MHz Band**

#### **I. Overview**

In a Public Notice released on March 8, 2013, the FCC sought public comment on the request of PTC-220, LLC (“PTC-220”) for waiver of Sections 90.723(f) and 90.729(b) of the Commission’s rules to facilitate deployment of positive train control (PTC) systems in the United States. Specifically, PTC-220 requests both a waiver of Section 90.729(b)’s limits to allow operation in the upper 221-222 MHz band to exceed 50 watts Effective Radiated Power (ERP) with antenna Height Above Average Terrain (HAAT) greater than 7 meters. PTC-220 also requests a waiver of Section 90.723(f), which requires coordination of Phase II 220-222 MHz licensees’ facilities to ensure that certain base or fixed station frequencies are selected to avoid interference in the 220-222 MHz band. In its waiver request, PTC-220 is seeking the ability to operate fixed stations in 221-222 MHz at up to 500 watts ERP.

In this paper we analyze the potential of PTC-220’s waiver request to cause interference to existing and future operations in the 220-222 MHz band. We also analyze the effectiveness of PTC-220’s proposed coordination methodology to both reduce the potential for harmful interference and resolve conditions where harmful interference is introduced.

#### **II. The PTC-220 Waiver**

Through its waiver, PTC-220 seeks to “maximize the use of its current licenses for its members and other railroads that may need to lease PTC spectrum capacity.” PTC-220 has elected, and obtained waivers, to operate a time division duplex (TDD) technology in the 220-222 MHz band for use in its positive train control operation. The 220-222 MHz band is arranged for frequency division duplex (FDD) technology and the current rules governing use in this band are designed to provide for FDD operation on a non-interfering basis.<sup>15</sup>

PTC-220 proposes to protect receivers operating in the 221-222 MHz band through the following protection criteria:

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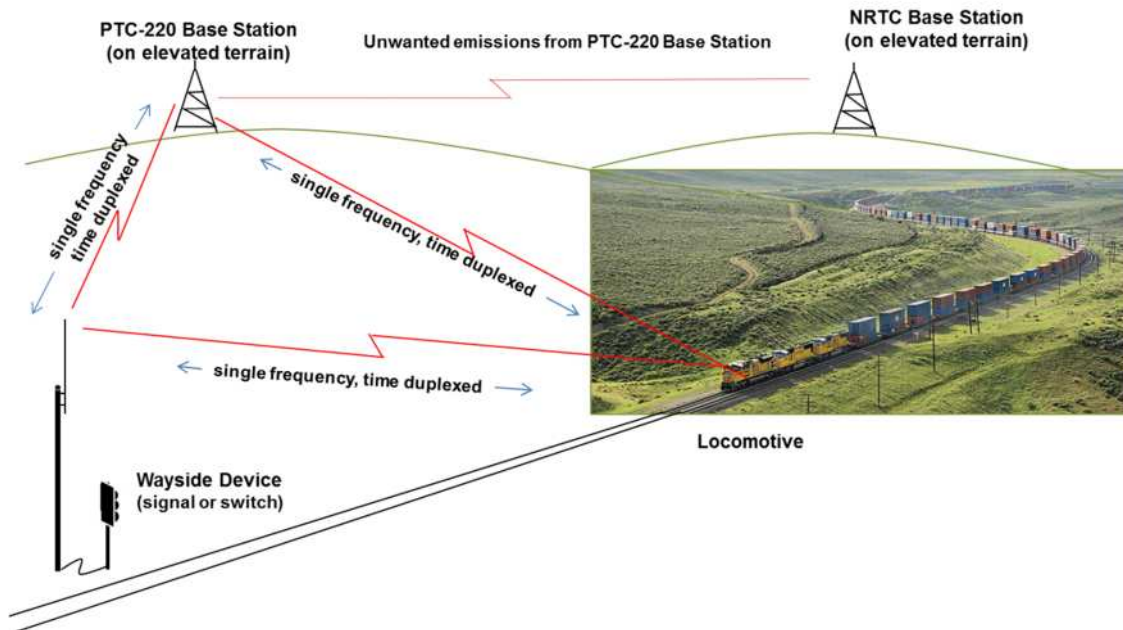
<sup>15</sup> This is accomplished through a.) designating separate sub-bands, the lower one MHz of the band for high power fixed base station operation and the upper one MHz of the band for generally low power mobile station or fixed remote station operation; b.) imposing antenna height and radiated power limits separately for base station, mobile station, and fixed remote station operation; c.) additional radiated power limits for transmitters operated near the edge of its sub-band to prevent harmful interference to receivers operated in the adjacent sub-band.

Scenario	Requirement
<b>To protect Phase I Licensees</b>	
For Phase I licensee receivers within 25 kHz and 6 km of a proposed PTC transmitter	No PTC transmitter would be permitted without the concurrence of the Phase I licensee
For Phase I licensee receivers within 25-200 kHz and 6 km of a proposed PTC transmitter	Apply geographic separation/ERP limits in accordance with the table in Section 90.723(d) of the Commission's rules
<b>To protect Phase II and nationwide Phase I Licensees</b>	
For <i>existing</i> Phase II and nationwide Phase I receivers within 25 kHz and 6 km of a proposed PTC transmitter	No PTC transmitter would be permitted without the concurrence of the Phase II or nationwide Phase I licensee
For <i>existing</i> Phase II and nationwide Phase I receivers within 25-200 kHz and 6 km of a proposed PTC transmitter	Apply geographic separation/ERP limits in accordance with the table in Section 90.723(d) of the Commission's rules
For <i>existing</i> Phase II and nationwide Phase I receivers within 25 kHz and between 6 and 10 km of a proposed PTC transmitter	Notify the licensee of the proposed site. If requested, produce an engineering study showing that the degradation of the noise floor due to the PTC transmitter at the potential victim site will be 2 dB or less. (The study could be based on computer prediction, actual measurements, or both.) The parties could agree on relaxed criteria.
For <i>new</i> Phase II and nationwide Phase I receivers	Require coordination between the licensees

### III. Background on Interference Sources

The PTC-220 waiver will introduce fixed high power transmitters and fixed receivers operating in the same 221-222 MHz frequency segment. This scenario is depicted in Figure 1 below.

**Figure 1. Operating scenario resulting from PTC-220 waiver request**



Unwanted emissions in the 221-22 MHz frequency band segment from the PTC-220 transmitter will arrive at the NRTC base station which receives signals typically transmitted from remote locations in the 221-222 MHz frequency band segment. As shown in the figure, both the PTC-220 and NRTC base station locations are likely to be on elevated terrain, principally to maximize the coverage area of the respective base stations. Unwanted emissions from the PTC-220 base station may be present at the NRTC base station and given the favorable propagation conditions that are likely between the elevated locations, these signals can be strong and may result in interference.<sup>16</sup>

The two primary sources of potential interference caused by PTC-220 base station transmitters to NRTC base stations receivers are:

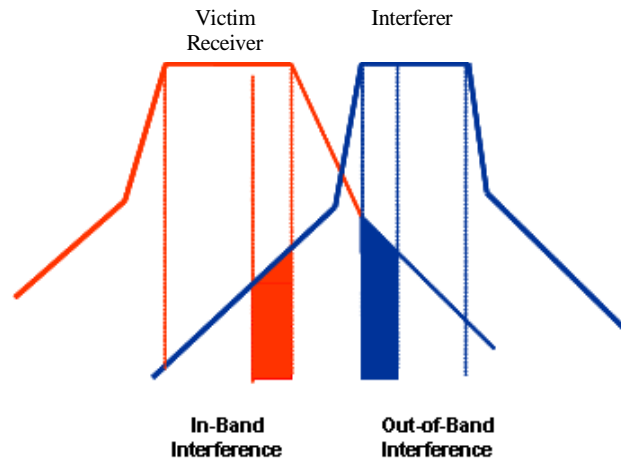
- a) Co-Channel Interference, which is caused by out-of-band emissions (OOBE, also known as in-band interference) from an undesired transmitter, is defined as emissions that are outside the bandwidth of an allocated channel in which a transmitter is operating that falls within the band pass of a neighboring receiver. Out-of-band emissions limits are characterized such that they may not exceed a specified power level, regardless of the fundamental transmit power.

<sup>16</sup> For example, NRTC base station antennas are typically located 30 – 45 meters above local terrain. However, in some instances, particularly sites NRTC has deployed in more urban areas, antennas may be located in excess of 200 meters above ground level.

- b) Adjacent Channel Interference (or Overload) is interference caused by extraneous power from a signal transmitted in an adjacent channel or band. The effects of adjacent channel interference are a function of both the amount of adjacent channel power present and the operating characteristics of the receiver. Adjacent channel power is always present, but when conditions are sufficient the adjacent channel power degrades the linearity of the receiver's amplifier (amplification capability) or compresses the available digital to analog conversion bits, such that the receiver can no longer accommodate the desired signal.

The effect of OOB and Overload from PTC-220 base station transmissions on NRTC base station receivers is depicted in Figure 2 below.

**Figure 2. Effect of OOB as in-band interference and overload as out-of-band interference**



#### IV. Path Loss Relationship and System Assumptions

The following relationship is utilized to calculate the propagation path loss between a PTC-220 base station transmitter and NRTC base station receiver.

$$PL_{dB} = n * 10 * \log_{10}(d_{meters}) + 20 * \log_{10}(f_{MHz}) - 27.55$$

For purposes of this analysis, it is assumed that the propagation loss exponent, will vary from  $n = 2$ , free space, to  $n = 2.4$ , which is commonly applied when line of sight conditions exist due to the transmitter and receiver being elevated above local terrain and clutter.<sup>17</sup>

<sup>17</sup> See for example, *Ex Parte* filing by the Aerospace and Flight Test Radio Coordinating Council (AFTRCC) in WT Docket No 070293; IB Docket No. 95-91; GEN Docket No. 90-357 dated November 21, 2008; and GE Healthcare *Ex Parte* ET Docket No. 08-59 dated October 30, 2008.



The base stations in NRTC's deployed system utilize a variety of directional and omnidirectional antennas that contribute from 0 dBd to 6 dBd of antenna gain. As all of the antenna pattern and gain characteristics cannot be easily considered in this analysis, the NRTC base station is instead assumed to employ an omnidirectional antenna with sufficient gain to offset feeder and connector losses between the antenna and receiver. While in some cases antenna directivity can result in a lower unwanted signal power being received by the NRTC base station, we cannot assume that the PTC and NRTC base stations will necessarily be configured to take best advantage of the antenna directivity and in some instances the antenna gain and directivity will actually *increase* the amount of unwanted signal level that is received. The isotropic radiator assumption is therefore a reasonable if not conservative assumption.

The NRTC base station is assumed to operate with a receive bandwidth of 12.5 kHz. While the 220-222 MHz band is organized according to 5 kHz channels, licensees are permitted to combine channels and the 12.5 kHz is the most common configuration in the NRTC system. The receiver sensitivity in a 12.5 kHz channel is assumed to be -110 dBm. The contribution of thermal noise and other environmental noise sources in the receiver sensitivity is assumed to be -120 dBm/12.5 kHz.

While little is known about the proposed configuration for PTC-220 base stations, applying the same logic as was applied to the NRTC base stations, it is assumed that the PTC-220 sites employ omnidirectional antennas. Transmitters in the 220-222 MHz band are required to comply with Emissions Mask F specified in Section 90.210(f) as:

from center of authorized bandwidth ( $f_o$ ) to edge of authorized bandwidth ( $f_e$ ): 0 dB,

from  $0 < f_e \leq 1.25$  kHz: *lesser of 65 dB or  $55 + 10\log_{10}(P)$* , and

from  $1.25 \text{ kHz} < f_e$ :  $55 + 10\log_{10}(P)$

Although a measurement bandwidth is not specified, other subparts of Section 90.210 specify 100 Hz resolution bandwidth. NRTC's analysis of FCC Equipment Authorization test reports for equipment authorized in the 220-222 MHz band suggest that 100 Hz and 300 Hz measurement bandwidths are applied interchangeably. For the purpose of this analysis it is assumed that the PTC-220 base station achieves a nominal emissions mask of  $55 + 10\log_{10}(P)$ , which is equivalent to -25 dBm/100 Hz or -4 dBm/12.5 kHz, and provides no additional OOB attenuation above the specified level.

## **V. Effect of Co-Channel Interference (OOBE)**

As described above, emissions that lie outside the allocated channel bandwidth of the PTC-220 transmitter have the potential to fall within the band pass of a NRTC receiver and degrade its performance.

To analyze potential OOB interference, a 1 dB rise in the effective noise level is considered harmful interference. For an effective noise level of -120 dBm/12.5 kHz, the out of band emissions level from the PTC-220 base station transmitter may not exceed -126 dBm at the antenna of the NRTC base station receiver.

For the PTC-220 transmitter operating with out of band emissions of -4 dBm/12.5 kHz, 122 dB of path loss is required to sufficiently attenuate those out of band emissions to ensure they are below the specified limit. Using the path loss relationship provided above, the required separation distances are provided in Table I:

**Table 1. Required separation distances between PTC-220 transmitters and NRTC receivers to prevent harmful OOB interference**

Path Loss Exponent ( <i>n</i> )	Required Separation Distance
2	136.5 km
2.4	19.0 km

The 19 km minimum separation far exceeds the 6 km coordination limit proposed by PTC-220 in its waiver request. At 6 km, and for a path loss exponent of 2.4, a PTC-220 transmitter will produce an OOB level of -114 dBm at the NRTC base station receiver, or a noise level *4 times* greater than the thermal and environmental noise level present at the receiver.

A separation distance of 19 km, or 11.8 miles, will result in an “exclusion zone” in excess of 400 square miles around a PTC-220 transmitter where the operation of a NRTC receiver will be degraded, or potentially rendered inoperable, due to elevated noise floor and reduced receiver sensitivity.<sup>18</sup> Considering that some of NRTC’s electric utilities have service areas that on average an electric cooperative serves 7,500 square miles, a single exclusion zone would impair at least 5% of an electric utilities’ service area.<sup>19</sup>

## VI. Effect of Adjacent Channel Interference (Overload)

Extraneous power from a signal transmitted in an adjacent channel or band, of sufficient power, can degrade the receiver linearity, capture the automatic gain control of the amplifier, or compresses the available digital to analog conversion bits. In such condition, the receiver is in an overload state and can no longer accommodate the desired signal.

<sup>18</sup> It should be noted that this is independent of the Effective Radiated Power of the PTC-220 transmitter. Modifying the PTC-220 request to reduce the ERP limit to less than 500 Watts will have no measureable effect on OOB interference. Reduction of OOB interference is accomplished through more stringent regulations on the emissions mask.

<sup>19</sup> NRTC’s review of operational statistics of its members reveals that the majority of services areas are 1,200 square miles to 14,000 square miles in extent, suggesting an average size of approximately 7,500 square miles.

To analyze potential receiver overload impairments, the NRTC receiver is assumed to have a Receiver Blocking level of -25 dBm. This is a representative figure for the different receivers utilized in the NRTC system.

Applying the -25 dBm metric and the path loss relationship described above to the proposed limits derived from Section 90.723(d) yields the following results:

**Table 2. Required separation distances between PTC-220 transmitters and NRTC receivers to prevent harmful overload interference**

FCC Coordination Distance (km)		FCC Radiated Power Limit		Required Path Loss	Required Separation Distance (km)	
Low	High	ERP (Watts)	ERP (dBW)	Path Loss (dB)	n = 2	n = 2.4
0	0.3	N/A				
0.3	0.5	5	7.0	64.1	0.2	0.1
0.5	0.6	10	10.0	67.1	0.2	0.1
0.6	0.8	20	13.0	70.1	0.3	0.1
0.8	2	25	14.0	71.1	0.4	0.1
2	4	50	17.0	74.1	0.5	0.2
4	5	100	20.0	77.1	0.8	0.3
5	6	200	23.0	80.1	1.1	0.3
6		500	27.0	84.1	1.7	0.5

While the overload impairment analysis provided in Table 2 is more promising, suggesting that the limits derived from Section 90.723(d) should generally protect *existing* NRTC base stations, the results nonetheless confirm that there is a very real potential for overload interference to NRTC receivers in close proximity of PTC-220 transmitters. In more urbanized areas, PTC-220 is likely to reduce the ERP of its transmitters and increase density of the transmitter site deployment for better ground level coverage and frequency utilization. In such instances, while

smaller in size, the sheer number of exclusion zones that NRTC would need to consider may frustrate efforts to deploy *new* NRTC base stations.<sup>20</sup>

## **VII. Conclusion**

It can be concluded from the foregoing analysis that if PTC-220 base stations sites are permitted to transmit in the 221-222 MHz band segment then harmful co-channel interference (attributable to the out of band emissions of the PTC-220 transmitter) and adjacent channel interference (resulting from strong adjacent channel signals overloading the receiver) to NRTC base stations will result. The analysis has shown that while both co- and adjacent channel interference is likely, OOB emissions are particularly problematic as the required separation distance to prevent interference is at least 19 km. While the ERP limits of Section 90.723(d) do appear to provide reasonable protection to existing NRTC base station receivers, interference does still occur and NRTC will be limited in the placement and operation of new base stations according to the exclusion zones that PTC-220's operations will generate.

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<sup>20</sup> The number of acceptable locations for new NRTC sites is finite due not only to clutter and propagation conditions but also the practical limitations of real estate acquisition, zoning, and permitting for the construction of new sites.